

#### 4.2.1.9 Public and Occupational Health and Safety

The assessments of potential radiological and chemical impacts associated with the storage alternatives at Hanford are presented in this section. Summaries of radiological impacts from normal operations are presented in Tables 4.2.1.9–1 and 4.2.1.9–2 for the public and workers, respectively. Impacts from hazardous chemicals are presented in Table 4.2.1.9–3. Summaries of impacts associated with postulated accidents are given in Tables 4.2.1.9–4 through 4.2.1.9–7. Detailed results are presented in Appendix M.

##### Preferred Alternative: No Action Alternative

This section describes the radiological and hazardous chemical releases and their associated impacts resulting from normal operations involving the Hanford sitewide missions, including interim storage of Pu. The impacts would be within applicable regulatory limits. For facility accidents, the risks and consequences are described in site safety documentation.

**Normal Operation.** The current mission at Hanford, where Pu is in interim storage, is described in Section 3.2. The site has identified those facilities that will continue to operate under the No Action Alternative, including interim Pu storage facilities and others, if any, that will become operational by 2005. Based on that information, the radiological and chemical releases to the environment in 2005 and beyond (future operation) were developed and used in the impact assessments. The resulting doses and potential health effects on the public and workers at Hanford are described below.

Under the No Action Alternative, Hanford would continue to store Pu-bearing materials in the storage vaults and approved vault-type rooms of the PFP. All Pu materials would be stabilized and repackaged, as necessary, to ensure safe storage. Activities supporting stabilization, repackaging, and storage of the Pu materials are identified and discussed in the *DNFSB Recommendation 94-1 Hanford Site Integrated Stabilization Management Plan* (VHC-EP-0853). This plan calls for transforming the Pu-bearing materials to a stable form that meets the DOE standard *Criteria for Safe Storage of Pu Metals and Oxides* (DOE-STD-3013-94) by 2002 for materials with greater than 50 percent Pu. Some PFP plant systems that are required to provide basic facility services would be upgraded for storage facility operations for the No Action Alternative.

**Radiological Impacts.** Under this alternative at Hanford, Table 4.2.1.9–1 presents the calculated annual dose to the average and MEI of the public, from total site operation, the projected fatal cancer risks to these individuals from 50 years of operation, the dose to the population within 80 km (50 mi) due to total site operation in the year 2030, and the projected number of fatal cancers in this population from 50 years of operation. The annual dose of  $5.3 \times 10^{-3}$  mrem to the MEI is within the radiological limits specified in NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5. From 50 years of operation, the corresponding risk of fatal cancer to this individual would be  $1.3 \times 10^{-7}$ . The annual dose of 1.6 person-rem to the population of 621,000 would be within the limit in proposed 10 CFR 834. The corresponding number of fatal cancers in this population from 50 years of operation would be 0.039. To put operational doses into perspective, comparisons with natural background radiation doses are included in the table. The doses and projected fatal cancers associated with the storage component of the No Action Alternative are included in Table 4.2.1.9–1. These are seen to be much lower than those from total site operations.

Under the No Action Alternative shown in Table 4.2.1.9–2, the annual average dose to a noninvolved (No Action) site worker and the annual dose to the noninvolved (No Action) total site workforce would be 31 mrem and 296 person-rem, respectively. The associated risk of fatal cancer to the average worker from 50 years of total site operations would be  $6.0 \times 10^{-4}$  and the projected number of fatal cancers from 50 years of total site operations would be 5.1.

The annual average dose to a worker involved in No Action storage operations would be 250 mrem/year, with a total involved No Action workforce dose of 49 person-rem. The increased risk of latent cancer fatality to the

**Table 4.2.1.9–3. Potential Hazardous Chemical Impacts to the Public and Workers During Normal Operation at Hanford Site—No Action and Storage Alternatives**

| Receptor                                     | No Action               | Upgrade               |                         | Consolidation         |                         | Collocation           |                         |
|--|-------------------------|-----------------------|-------------------------|-----------------------|-------------------------|-----------------------|-------------------------|
|  | Total Site <sup>a</sup> | Facility <sup>b</sup> | Total Site <sup>a</sup> | Facility <sup>b</sup> | Total Site <sup>a</sup> | Facility <sup>b</sup> | Total Site <sup>a</sup> |
| <b>Maximally Exposed Individual (Public)</b> |                         |                       |                         |                       |                         |                       |                         |
| Hazard Index <sup>c</sup>                    | $6.2 \times 10^{-5}$    | $9.4 \times 10^{-7}$  | $6.3 \times 10^{-5}$    | $4.0 \times 10^{-6}$  | $6.6 \times 10^{-5}$    | $1.6 \times 10^{-5}$  | $7.8 \times 10^{-5}$    |
| Cancer risk <sup>d</sup>                     | 0                       | 0                     | 0                       | $2.7 \times 10^{-8}$  | $2.7 \times 10^{-8}$    | $2.7 \times 10^{-8}$  | $2.7 \times 10^{-8}$    |
| <b>Worker Onsite</b>                         |                         |                       |                         |                       |                         |                       |                         |
| Hazard Index <sup>e</sup>                    | $4.0 \times 10^{-3}$    | $1.9 \times 10^{-5}$  | $4.0 \times 10^{-3}$    | $2.8 \times 10^{-4}$  | $4.3 \times 10^{-3}$    | $7.1 \times 10^{-4}$  | $4.7 \times 10^{-3}$    |
| Cancer risk <sup>f</sup>                     | 0                       | 0                     | 0                       | $1.2 \times 10^{-5}$  | $1.2 \times 10^{-5}$    | $1.2 \times 10^{-5}$  | $1.2 \times 10^{-5}$    |

<sup>a</sup> Total=Sum of the No Action plus the contributions of the above activity.

<sup>b</sup> Facility=Contribution from the above activity only (for example, the amount of increase over the existing, No Action level at the site).

<sup>c</sup> Hazard index for MEI=Sum of Individual Hazard Quotients (Noncancerous health effects) for MEI.

<sup>d</sup> Cancer risk for MEI=(Emissions for 8-hr) x (0.286 [Converts concentrations to doses]) x (Slope Factor [SF]).

<sup>e</sup> Hazard index for workers=Sum of Individual Hazard Quotients (Noncancerous health effects) for workers.

<sup>f</sup> Cancer risk for workers=(Emissions for 8-hr) x (0.286 [Converts concentrations to doses]) x (0.237 [Fraction of year exposed]) x (0.571 [Fraction of lifetime working]) x (SF).

Note: Where there are no known carcinogens among the hazardous chemicals emitted, there are no slope factors, therefore the calculated risk value is 0.

Source: Section M.3, Tables M.3.4–1 through M.3.4–4.

average No Action worker from 50 years of operation would be  $5.0 \times 10^{-3}$ , and the projected number of latent fatal cancers to the No Action workforce from 50 years of operation would be 0.92.

**Hazardous Chemical Impacts.** Hazardous chemical impacts to the public resulting from the normal operation under No Action at Hanford are presented in Table 4.2.1.9–3. The hazardous chemical impacts from current site operations represent the baseline site impacts for the various storage alternatives. The noncancerous health effects and the risk of cancer due to the total chemical exposures were estimated. Since the major releases due to normal operation at Hanford are expected to make up nearly all of the exposures to onsite workers and to the public in adjacent communities, contributions to the hazardous chemical concentrations from all other sources (for example, industrial operations) are considered negligible for purposes of risk calculations.

The HI to the MEI of the public at Hanford resulting from normal operation under the No Action Alternative is  $6.2 \times 10^{-5}$ , and the cancer risk from hazardous chemicals is zero (because no carcinogens are released from the hazardous chemicals used). The HI to the onsite worker is  $4.0 \times 10^{-3}$ , and the cancer risk is zero (because no carcinogens are released from the hazardous chemicals used).

**Facility Accidents.** Under the No Action Alternative, Pu would continue to be stored at Hanford in existing facilities. These facilities currently operate in accordance with DOE Orders which ensure that the risk to the public of prompt fatalities due to accidents or cancer fatalities due to operations will be minimized. The safety to workers and the public from accidents at existing facilities is also controlled by Technical Safety Requirements specified in detail in a Safety Analysis Report (SAR) or a Basis for Interim Operations document prepared and maintained specifically for a facility or process within a facility. Under these controls, any change in approved operations or to facilities would cause a halt in operations until it can be established that worker and public safety has not been compromised.

The *Plutonium Finishing Plant Safety Analysis Report* (WHC-SD-CP-SAR-021) analyzes a wide spectrum of accidents that are primarily associated with processing rather than vault storage. This is because a release from a vault would require more severe accident conditions than are normally analyzed in an SAR. The accidents in

the SAR consist of potential process accidents such as fires, explosions, and criticality as well as an externally initiated aircraft crash and earthquake. An estimate of the effects of potential accidents in the existing storage vault at Hanford can be derived from similar storage accidents that have been postulated for an upgraded storage facility. A severe consequence, low frequency accident for storage under the No Action Alternative would be a beyond design basis earthquake. If this accident were to occur, there would be an estimated 0.12 latent cancer fatalities in the offsite population within 80 km (50 mi). The estimated frequency of the earthquake with sufficient damage to cause a release is approximately  $1.0 \times 10^{-7}$  per year, which corresponds to a risk of  $1.2 \times 10^{-8}$  latent cancer fatalities per year. For the MEI and noninvolved worker, there would be  $1.7 \times 10^{-5}$  and  $2.2 \times 10^{-3}$  latent cancer fatalities, respectively, if the accident occurred. The risks would be  $1.7 \times 10^{-12}$  and  $2.2 \times 10^{-10}$  latent cancer fatalities per year. A potentially more frequent accident is penetration of the PCV caused by corrosion. If this accident were to occur, the estimated number of cancer fatalities in the offsite population would be  $1.3 \times 10^{-3}$ . The estimated frequency of this accident is  $6.4 \times 10^{-3}$  per year, which corresponds to a risk of  $8.3 \times 10^{-5}$  cancer fatalities per year. For the MEI and noninvolved worker the corresponding impacts are  $1.8 \times 10^{-7}$  and  $1.8 \times 10^{-5}$  latent cancer fatalities, respectively, if the accident occurred. The risks would be  $1.2 \times 10^{-9}$  and  $1.2 \times 10^{-7}$  latent cancer fatalities per year.

### Upgrade Alternative

This section describes the radiological and hazardous chemical releases and their associated impacts resulting either from normal operation or from accidents involved with the modified FMEF or a new storage facility at Hanford. The section describes the impacts from normal facility operations at Hanford, followed by a description of impacts from facility accidents.

During normal operation at Hanford, the operation of any of these Pu storage facilities would result in impacts that are within applicable regulatory limits.

[Text deleted.]

### *Upgrade Without Rocky Flats Environmental Technology Site Plutonium or Los Alamos National Laboratory Plutonium Subalternative*

#### *Modify Existing Fuels and Materials Examination Facility for Plutonium Storage*

**Normal Operation.** There would be no radiological releases during the modification of the FMEF at Hanford. Construction worker exposures to material potentially contaminated with radioactivity (for example, from construction activities involved with existing contaminated soil) would be limited to assure that doses are maintained as low as reasonably achievable (ALARA). Toward this end, construction workers would be monitored as appropriate. Limited hazardous chemical releases are anticipated as a result of the construction activities. However, concentrations would be within the regulated exposure limits. During normal operation, there would be radiological and hazardous chemical releases to the environment as well as direct exposures. The resulting doses and potential health effects on the public and workers at Hanford are described below.

**Radiological Impacts.** Doses to the public from storage would be expected to decrease from No Action for the Upgrade Alternative, as shown in Table 4.2.1.9-1. This is because the storage facility safety and design features would improve. The dose to the MEI of the public due to annual storage facility operation would be  $1.8 \times 10^{-6}$  mrem. From 50 years of operation, the corresponding risk of fatal cancer to this individual would be  $4.5 \times 10^{-11}$ . The impacts to the average individual would be less. As a result of storage facility operation in the year 2030, the population dose would be  $4.7 \times 10^{-5}$  person-rem. The corresponding number of fatal cancers in this population due to 50 years of operation would be  $1.2 \times 10^{-6}$ .

The dose to the MEI due to annual total site operations is within the radiological limits specified in NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5, and would be  $5.1 \times 10^{-3}$  mrem. From 50 years of operations, the

corresponding risk of fatal cancer to this individual would be  $1.3 \times 10^{-7}$ . These values are presented in Table 4.2.1.9–1. The impacts to the average individual would be less. This activity would be included in a program to ensure that doses to the public are ALARA. As a result of total site operations in the year 2030, the population dose would be within the limit in proposed 10 CFR 834 and would be 1.5 person-rem. The corresponding number of fatal cancers in this population from 50 years of operation would be 0.038.

Doses to onsite workers from normal operations are given in Table 4.2.1.9–2. Included are involved workers directly associated with the modified facility for Pu storage, workers who are not involved with the modified facility, and the entire workforce at Hanford. All doses fall within regulatory limits and administrative control levels. The associated risks and numbers of fatal cancers among the different workers from 50 years of operation are included in the table. Dose to individual workers would be kept low by instituting badged monitoring and ALARA programs and also workers rotations. As a result of the implementation of these mitigation measures, the actual number of fatal cancers calculated would be lower for the operation of this facility

**Hazardous Chemical Impacts.** Hazardous chemical impacts to the public and to the onsite worker resulting from the normal operations of the upgraded storage facilities at Hanford are presented in Table 4.2.1.9–3. The impacts from all site operations, including the upgraded storage facilities are also included in this table. Total site impacts, which include the No Action impact plus the facility are provided. All analyses to support the values presented in this table are provided in Section M.3.

The HI from the facility to the MEI of the public is  $9.4 \times 10^{-7}$ , and the cancer risk from hazardous chemicals from the facility is zero (because no carcinogens are released from the hazardous chemicals used) as a result of operation of the upgraded storage facilities in the year 2030. The HI and cancer risk would remain constant over 50 years of operation, because exposures would be expected to remain the same. The total site operation, including the upgrade facility, would result in an HI of  $6.3 \times 10^{-5}$  and a cancer risk of zero (because no carcinogens are released) for the MEI in the year 2030. This would be expected to remain constant as a result of 50 years of operation.

The HI from the facility to the onsite worker would be  $1.9 \times 10^{-5}$  and the cancer risk from the facility is zero (because no carcinogens are released from the hazardous chemicals used) as a result of operation of the upgraded storage facilities in the year 2030. The HI and cancer risk would remain constant over 50 years of operation, provided exposures remain the same. The total site operation including the upgrade facility would result in an HI of  $4.0 \times 10^{-3}$  and a cancer risk of zero (because no carcinogens are released) for the worker in the year 2030. This would be expected to remain constant as a result of 50 years of operation.

**Facility Accidents.** Modification of the existing Pu storage facilities at the Hanford site may change the existing risks of accidents to workers and the public. Under this action, the FMEF would be modified and would be in compliance with applicable DOE Orders and other regulations and standards. This may result in a reduction of risk compared to No Action.

A set of potential accidents have been postulated for upgraded storage at FMEF of existing Pu without LANL or RFETS Pu for which there may be releases of Pu that may impact onsite workers and the offsite population. The accident consequences and risks to a worker located 1,000 m (3,280 ft) from the accident release point, the maximum offsite individual located at the site boundary, and the population located within 80 km (50 mi) of the accident release point are summarized in Table 4.2.1.9–4. For the set of accidents analyzed, the maximum number of cancer fatalities in the population within 80 km (50 mi) would be 0.12 at Hanford for the beyond design basis earthquake accident scenario with an estimated probability of  $1.0 \times 10^{-7}$  per year (for example, probability of severe earthquake occurring is estimated to be about  $1.0 \times 10^{-5}$ , once in 100,000 years, multiplied by a damage and release probability of 0.01). The corresponding 50-year facility lifetime risk from the same accident scenario for the population, maximum offsite individual, and worker at 1,000 m (3,280 ft), would be  $6.1 \times 10^{-7}$ ,  $8.3 \times 10^{-11}$ , and  $1.1 \times 10^{-8}$ , respectively. The maximum population 50-year facility lifetime risk would

be  $4.2 \times 10^{-4}$  (for example, one fatality in over 100,000 years) at Hanford for the PCV penetration by corrosion accident scenario with a probability of  $6.4 \times 10^{-3}$  per year. The corresponding maximum offsite individual and worker 50-year facility lifetime risks would be  $5.7 \times 10^{-8}$  and  $5.7 \times 10^{-6}$ , respectively. Section M.5 presents additional facility accident data and summary descriptions of the accident scenarios identified in Table 4.2.1.9–4.

Involved workers, those that would work in the facilities associated with the proposed action, may be subject to injury and, in some cases, fatality as a result of potential accidents. The locations of workstations, number of workers, personnel protective features, engineered safety features, and other design details affect the extent of worker exposures to accidents. Certain accidents such as fires, explosions, and criticality could cause fatalities to workers close to the accident. Prior to construction of a new or modification of an existing facility, DOE Orders require detailed safety analyses to assure that facility designs and operating procedures limit the number of workers in hazardous areas and minimize risk of injury or fatality in the event of an accident.

#### *Construct New 200 West Area Facility for Plutonium Storage*

**Normal Operation.** There would be no radiological releases during the construction of new storage facilities at Hanford. Construction worker exposures to material potentially contaminated with radioactivity (for example, from construction activities involved with existing contaminated soil) would be limited to assure that doses are maintained ALARA. Toward this end, construction workers would be monitored as appropriate. Limited hazardous chemical releases are anticipated as a result of the construction activities. However, concentrations would be within the regulated exposure limits. During normal operation, there would be radiological and hazardous chemical releases to the environment as well as direct exposures. The resulting doses and potential health effects to the public and workers at Hanford are described below.

**Radiological Impacts.** The doses and associated health risks to the public associated with this new storage facility are expected to be even smaller than those for the modified FMEF. Total site doses and resulting health risks would be virtually the same for both storage facilities. The doses and associated health risks to workers are assumed to be the same as for the modified FMEF (Table 4.2.1.9–2). This is because the operations would be similar and the amount of material handled would be the same.

**Hazardous Chemical Impacts.** Hazardous chemical emissions from the new Pu storage facility would be less than the emissions from the modified FMEF. The resultant health risks to the public and workers from hazardous chemical emissions associated with this new storage facility would be even smaller than those given in Table 4.2.1.9–3 for the modified FMEF.

**Facility Accidents.** A new Pu storage facility for continued storage of Pu would incorporate new safety features that should reduce the consequences and risks of accidents compared with No Action. The consequences and risks of accidents for this new facility would be bounded by the consequences and risks presented in Table 4.2.1.9–4 for the upgraded FMEF at Hanford.

Involved workers, those that would work in the facilities associated with the proposed action, may be subject to injury and, in some cases, fatality as a result of potential accidents. The locations of workstations, number of workers, personnel protective features, engineered safety features, and other design details affect the extent of worker exposures to accidents. Certain accidents such as fires, explosions, and criticality could cause fatalities to workers close to the accident. Prior to construction of a new or modification of an existing facility, DOE Orders require detailed safety analyses to assure that facility designs and operating procedures limit the number of workers in hazardous areas and minimize risk of injury or fatality in the event of an accident.

**Table 4.2.1.9–4. Upgrade Without Rocky Flats Environmental Technology Site or Los Alamos National Laboratory Material Alternative—Accident Impacts at Hanford Site**

| Accident Description                | Worker at<br>1,000 m                                      |   | Maximum Offsite<br>Individual                             |   | Population to<br>80 km                                      |  | Accident<br>Frequency<br>(per yr) |
|-------------------------------------|---|---|---|---|---|--|-----------------------------------|
|                                     | Risk of<br>Cancer<br>Fatality<br>(per 50 yr) <sup>a</sup> | Probability<br>of Cancer<br>Fatality <sup>b</sup> | Risk of<br>Cancer<br>Fatality<br>(per 50 yr) <sup>a</sup> | Probability<br>of Cancer<br>Fatality <sup>b</sup> | Risk of<br>Cancer<br>Fatalities<br>(per 50 yr) <sup>a</sup> | Number of<br>Cancer<br>Fatalities <sup>c</sup> |                                   |
| PCV puncture by forklift            | $1.3 \times 10^{-7}$                                      | $4.4 \times 10^{-6}$                              | $1.3 \times 10^{-9}$                                      | $4.4 \times 10^{-8}$                              | $9.6 \times 10^{-6}$  | $3.2 \times 10^{-4}$                           | $6.0 \times 10^{-4}$              |
| PCV breach by<br>firearms discharge | $7.7 \times 10^{-9}$                                      | $4.4 \times 10^{-7}$                              | $7.7 \times 10^{-11}$                                     | $4.4 \times 10^{-9}$                              | $5.6 \times 10^{-7}$  | $3.2 \times 10^{-5}$                           | $3.5 \times 10^{-4}$              |
| PCV penetration<br>by corrosion     | $5.7 \times 10^{-6}$                                      | $1.8 \times 10^{-5}$                              | $5.7 \times 10^{-8}$                                      | $1.8 \times 10^{-7}$                              | $4.2 \times 10^{-4}$  | $1.3 \times 10^{-3}$                           | $6.4 \times 10^{-3}$              |
| Vault fire                          | $5.8 \times 10^{-9}$                                      | $1.2 \times 10^{-3}$                              | $4.6 \times 10^{-11}$                                     | $9.2 \times 10^{-6}$                              | $3.4 \times 10^{-7}$  | 0.067  | $1.0 \times 10^{-7}$              |
| Truck bay fire                      | $3.1 \times 10^{-9}$                                      | $6.1 \times 10^{-4}$                              | $3.1 \times 10^{-11}$                                     | $6.1 \times 10^{-6}$                              | $2.2 \times 10^{-7}$  | 0.045  | $1.0 \times 10^{-7}$              |
| Spontaneous combustion              | $3.1 \times 10^{-11}$                                     | $8.8 \times 10^{-7}$                              | $3.1 \times 10^{-13}$                                     | $8.8 \times 10^{-9}$                              | $2.2 \times 10^{-9}$  | $6.4 \times 10^{-5}$                           | $7.0 \times 10^{-7}$              |
| Explosion in the vault              | $7.2 \times 10^{-10}$                                     | $1.4 \times 10^{-4}$                              | $7.2 \times 10^{-12}$                                     | $1.4 \times 10^{-6}$                              | $5.3 \times 10^{-8}$  | 0.011  | $1.0 \times 10^{-7}$              |
| Explosion outside of vault          | $3.3 \times 10^{-11}$                                     | $6.6 \times 10^{-6}$                              | $3.3 \times 10^{-13}$                                     | $6.6 \times 10^{-8}$                              | $2.4 \times 10^{-9}$  | $4.8 \times 10^{-4}$                           | $1.0 \times 10^{-7}$              |
| Nuclear criticality                 | $2.1 \times 10^{-11}$                                     | $4.2 \times 10^{-6}$                              | $1.6 \times 10^{-13}$                                     | $3.3 \times 10^{-8}$                              | $1.8 \times 10^{-10}$                                       | $3.5 \times 10^{-5}$                           | $1.0 \times 10^{-7}$              |
| Beyond design basis<br>earthquake   | $1.1 \times 10^{-8}$                                      | $2.2 \times 10^{-3}$                              | $8.3 \times 10^{-11}$                                     | $1.7 \times 10^{-5}$                              | $6.1 \times 10^{-7}$  | 0.12   | $1.0 \times 10^{-7}$              |
| Expected risk <sup>d</sup>          | $5.8 \times 10^{-6}$                                      | —   | $5.8 \times 10^{-8}$                                      | —   | $4.3 \times 10^{-4}$  | —  | —                                 |

<sup>a</sup> The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years in operation.

<sup>b</sup> Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

<sup>c</sup> Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

<sup>d</sup> Expected risk is the sum of the risks for each accident over the 50-year lifetime of the facility.

Note: All values are mean values.

Source: Calculated using Table 4.2.1.9–6 data adjusted for existing inventory of Pu at Hanford.

### **Upgrade With All or Some Rocky Flats Environmental Technology Site Plutonium and Los Alamos National Laboratory Plutonium Subalternative**

#### **Modify Existing Fuels and Materials Examination Facility for Plutonium Storage**

**Normal Operation.** As described for the Upgrade Without RFETS or LANL Pu, there would be no radiological releases during the modification of the FMEF at Hanford. Construction worker exposures to material potentially contaminated with radioactivity would be limited to assure that doses are maintained ALARA. Toward this end, construction workers would be monitored as appropriate. Limited hazardous chemical releases are anticipated as a result of the construction activities. However, concentrations would be within the regulated exposure limits. During normal operation, there would be radiological and hazardous chemical releases to the environment as well as direct exposures. The resulting doses and potential health effects on the public and workers at Hanford are described below.

**Radiological Impacts.** During normal operations, there would be only a negligible difference in radiological impacts if Pu from the RFETS and LANL is included in the upgrade storage alternative. Therefore, the impacts are essentially the same as presented in the previous section, which discusses the upgrade without RFETS or LANL Pu.

**Hazardous Chemical Impacts.** Hazardous chemicals associated with storage of Pu from RFETS and LANL does not measurably contribute to hazardous chemical emissions from the facility for this subalternative. Therefore resultant hazardous chemical impacts to the public and worker are essentially the same as presented in the previous section, which discusses the upgrade without RFETS or LANL Pu.

**Facility Accidents.** Upgrade of the existing Pu storage facilities at the Hanford site may change the existing risks of accidents to workers and the public. Under upgrade, all Pu storage facilities would be brought into compliance with applicable DOE Orders and other regulations and standards. This may result in a reduction of risk compared to No Action.

A set of potential accidents have been postulated for the RFETS and LANL Pu storage increment for which there may be releases of Pu that may impact onsite workers and the offsite population. The accident consequences and risks to a worker located 1,000 m (3,280 ft) from the accident release point, the maximum offsite individual located at the site boundary, and the population located within 80 km (50 mi) of the accident release point are summarized in Table 4.2.1.9–5. For the set of accidents analyzed, the maximum number of cancer fatalities in the population within 80 km (50 mi) would be 0.12 at Hanford for the beyond design basis earthquake accident scenario with an estimated probability of  $1.0 \times 10^{-7}$  per year (for example, probability of severe earthquake occurring is estimated to be about  $1.0 \times 10^{-5}$ , once in 100,000 years, multiplied by a damage and release probability of 0.01). The corresponding 50-year facility lifetime risk from the same accident scenario for the population, maximum offsite individual, and worker at 1,000 m (3,280 ft), would be  $6.2 \times 10^{-7}$ ,  $8.5 \times 10^{-11}$ , and  $1.1 \times 10^{-8}$ , respectively. The maximum population 50-year facility lifetime risk would be  $4.3 \times 10^{-4}$  (for example, on fatality in over 100,000 years) at Hanford for the PCV penetration by corrosion accident scenario with a probability of  $6.6 \times 10^{-3}$  per year. The corresponding maximum offsite individual and worker 50-year facility lifetime risks would be  $5.9 \times 10^{-8}$  and  $5.9 \times 10^{-6}$ , respectively. Table 4.2.1.9–5 also shows the Combined Expected Risk for the upgraded storage of existing Pu, the RFETS Pu and the LANL Pu increment. Section M.5 presents additional facility accident data and summary descriptions of the accident scenarios identified in Table 4.2.1.9–5.

Involved workers, those that would work in the facilities associated with the proposed action, may be subject to injury and, in some cases, fatality as a result of potential accidents. The locations of workstations, number of workers, personnel protective features, engineered safety features, and other design details affect the extent of worker exposures to accidents. Certain accidents such as fires, explosions, and criticality could cause fatalities to workers close to the accident. Prior to construction of a new or modification of an existing facility, DOE Orders require detailed safety analyses to assure that facility designs and operating procedures limit the number of workers in hazardous areas and minimize risk of injury or fatality in the event of an accident.

#### *Construct New 200 West Area Facility for Plutonium Storage*

**Normal Operation.** As described for the Upgrade Without RFETS or LANL Pu, there would be no radiological releases during the construction of the new 200 West Area Facility. Construction worker exposures to material potentially contaminated with radioactivity (for example, from construction activities involved with existing contaminated soil) would be limited to assure that doses are maintained ALARA. Toward this end, construction workers would be monitored as appropriate. Limited hazardous chemical releases are anticipated as a result of the construction activities. However, concentrations would be within the regulated exposure limits. During normal operation, there would be radiological and hazardous chemical releases to the environment as well as direct exposures. The resulting doses and potential health effects to the public and workers at Hanford are described below.

**Radiological Impacts.** During normal operations, there would be only a negligible difference in radiological impacts if Pu from the RFETS and LANL is included in the upgrade storage alternative. Therefore, the impacts are essentially the same as presented in the previous section, which discusses the Upgrade Without RFETS or LANL Pu.

**Table 4.2.1.9–5. Upgrade With Rocky Flats Environmental Technology Site and Los Alamos National Laboratory Material Alternative—Accident Impacts at Hanford Site**

| Accident Description                  | Worker at<br>1,000 m                                      |   | Maximum Offsite<br>Individual                             |   | Population to<br>80 km                                      |  | Accident<br>Frequency<br>(per yr) |
|---------------------------------------|---|---|---|---|---|--|-----------------------------------|
|                                       | Risk of<br>Cancer<br>Fatality<br>(per 50 yr) <sup>a</sup> | Probability<br>of Cancer<br>Fatality <sup>b</sup> | Risk of<br>Cancer<br>Fatality<br>(per 50 yr) <sup>a</sup> | Probability<br>of Cancer<br>Fatality <sup>b</sup> | Risk of<br>Cancer<br>Fatalities<br>(per 50 yr) <sup>a</sup> | Number of<br>Cancer<br>Fatalities <sup>c</sup> |                                   |
| PCV puncture by forklift              | $1.3 \times 10^{-7}$                                      | $4.4 \times 10^{-6}$                              | $1.3 \times 10^{-9}$                                      | $4.4 \times 10^{-8}$                              | $9.6 \times 10^{-6}$  | $3.2 \times 10^{-4}$                           | $6.0 \times 10^{-4}$              |
| PCV breach by<br>firearms discharge   | $7.7 \times 10^{-9}$                                      | $4.4 \times 10^{-7}$                              | $7.7 \times 10^{-11}$                                     | $4.4 \times 10^{-9}$                              | $5.6 \times 10^{-7}$  | $3.2 \times 10^{-5}$                           | $3.5 \times 10^{-4}$              |
| PCV penetration<br>by corrosion       | $5.9 \times 10^{-6}$                                      | $1.8 \times 10^{-5}$                              | $5.9 \times 10^{-8}$                                      | $1.8 \times 10^{-7}$                              | $4.3 \times 10^{-4}$  | $1.3 \times 10^{-3}$                           | $6.6 \times 10^{-3}$              |
| Vault fire                            | $5.9 \times 10^{-9}$                                      | $1.2 \times 10^{-3}$                              | $4.7 \times 10^{-11}$                                     | $9.4 \times 10^{-6}$                              | $3.5 \times 10^{-7}$  | 0.069  | $1.0 \times 10^{-7}$              |
| Truck bay fire                        | $3.1 \times 10^{-9}$                                      | $6.1 \times 10^{-4}$                              | $3.1 \times 10^{-11}$                                     | $6.1 \times 10^{-6}$                              | $2.2 \times 10^{-7}$  | 0.045  | $1.0 \times 10^{-7}$              |
| Spontaneous combustion                | $3.1 \times 10^{-11}$                                     | $8.8 \times 10^{-7}$                              | $3.1 \times 10^{-13}$                                     | $8.8 \times 10^{-9}$                              | $2.2 \times 10^{-9}$  | $6.4 \times 10^{-5}$                           | $7.0 \times 10^{-7}$              |
| Explosion in the vault                | $7.4 \times 10^{-10}$                                     | $1.4 \times 10^{-4}$                              | $7.4 \times 10^{-12}$                                     | $1.4 \times 10^{-6}$                              | $5.4 \times 10^{-8}$  | 0.011  | $1.0 \times 10^{-7}$              |
| Explosion outside of vault            | $3.3 \times 10^{-11}$                                     | $6.6 \times 10^{-6}$                              | $3.3 \times 10^{-13}$                                     | $6.6 \times 10^{-8}$                              | $2.4 \times 10^{-9}$  | $4.8 \times 10^{-4}$                           | $1.0 \times 10^{-7}$              |
| Nuclear criticality                   | $2.1 \times 10^{-11}$                                     | $4.2 \times 10^{-6}$                              | $1.6 \times 10^{-13}$                                     | $3.3 \times 10^{-8}$                              | $1.8 \times 10^{-10}$                                       | $3.5 \times 10^{-5}$                           | $1.0 \times 10^{-7}$              |
| Beyond evaluation basis<br>earthquake | $1.1 \times 10^{-8}$                                      | $2.3 \times 10^{-3}$                              | $8.5 \times 10^{-11}$                                     | $1.7 \times 10^{-5}$                              | $6.2 \times 10^{-7}$  | 0.12   | $1.0 \times 10^{-7}$              |
| Expected risk <sup>d</sup>            | $6.0 \times 10^{-6}$                                      | —   | $6.0 \times 10^{-8}$                                      | —   | $4.3 \times 10^{-4}$  | —  | —                                 |
| Combined expected risk <sup>e</sup>   | $1.2 \times 10^{-5}$                                      | —   | $1.2 \times 10^{-7}$                                      | —   | $8.6 \times 10^{-4}$  | —  | —                                 |

<sup>a</sup> The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years in operation.

<sup>b</sup> Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

<sup>c</sup> Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

<sup>d</sup> Expected risk is the incremental risk for storing the additional RFETS and LANL material for each accident over the 50-year lifetime of the facility.

<sup>e</sup> Combined expected risk for base case without RFETS or LANL Pu material plus RFETS and LANL Pu material increment.

Note: All values are mean values.

Source: Calculated using in Tables 4.2.1.9–6. Data adjusted for additional RFETS and LANL Pu.

**Hazardous Chemical Impacts.** Hazardous chemicals associated with storage of Pu from RFETS and LANL associated with building a new Pu facility are essentially the same as presented in the previous section, which discusses the upgrade without RFETS or LANL Pu. The resultant hazardous chemical impacts to the public and worker are essentially the same as presented in the previous section.

**Facility Accidents.** The new 200 West Area Facility constructed for continued storage of Pu would incorporate new safety features that should reduce the consequences and risks of accidents compared with No Action. The consequences and risks of accidents for this facility would be bounded by the consequences and risks presented in Table 4.2.1.9–5 for the Modify Existing FMEF for Pu Storage Subalternative at Hanford.

Involved workers, those that would work in the facilities associated with the proposed action, may be subject to injury and, in some cases, fatality as a result of potential accidents. The locations of workstations, number of workers, personnel protective features, engineered safety features, and other design details affect the extent of worker exposures to accidents. Certain accidents such as fires, explosions, and criticality could cause fatalities to workers close to the accident. Prior to construction of a new or modification of an existing facility, DOE Orders require detailed safety analyses to assure that facility designs and operating procedures limit the number of workers in hazardous areas and minimize risk of injury or fatality in the event of an accident.

## Consolidation Alternative

### *Construct New Plutonium Storage Facility*

This section includes a description of radiological and hazardous chemical releases and their associated impacts resulting from either normal operation or accidents involving the new consolidated Pu storage facility at Hanford.

[Text deleted.]

**Normal Operation.** There would be no radiological releases during the construction of a new consolidated Pu storage facility at Hanford. Construction worker exposures to material potentially contaminated with radioactivity (for example, from construction activities involved with existing contaminated soil) would be limited to assure that doses are maintained ALARA. Toward this end, construction workers would be monitored as appropriate. Limited hazardous chemical releases are anticipated as a result of construction activities. However, concentrations would be within the regulated exposure limits. During normal operation, there would be radiological and hazardous chemical releases to the environment as well as direct in-plant exposures. The resulting doses and potential health effects to the public and workers at Hanford are described below.

**Radiological Impacts.** Radiological impacts to the public resulting from the normal operation of the new consolidated Pu storage facility are presented in Table 4.2.1.9–1. The impacts from all site operations, including the new consolidated Pu storage facility, are also given in the table. To put operational doses into perspective, comparisons of operational doses with natural background radiation doses are included in the table.

The dose to the MEI due to annual storage facility operation would be  $2.5 \times 10^{-6}$  mrem. From 50 years of operation, the corresponding risk of fatal cancer to this individual would be  $6.2 \times 10^{-11}$ . As a result of storage plant operation in the year 2030, the population dose would be  $1.1 \times 10^{-4}$  person-rem. The corresponding number of fatal cancers in this population due to 50 years of operation would be  $2.8 \times 10^{-6}$ .

The dose to the MEI due to annual total site operations is within the radiological limits specified in NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5 and would be  $5.1 \times 10^{-3}$  mrem. From 50 years of operation, the corresponding risk of fatal cancer to this individual would be  $1.3 \times 10^{-7}$ . The impacts to the average individual would be less. This activity would be included in a program to ensure that doses to the public are ALARA. As a result of total site operation in the year 2030, the population dose would be within the limit in proposed 10 CFR 834 and would be 1.5 person-rem. The corresponding number of fatal cancers in this population due to 50 years of operation would be 0.038.

Doses to onsite workers from normal operations are given in Table 4.2.1.9–2. Included are involved workers directly associated with the new consolidated Pu storage facility, workers who are not involved with the new storage facility, and the entire workforce at Hanford. All doses fall within regulatory limits and administrative control levels. The associated risks and numbers of fatal cancers among the different workers from 50 years of operation are included in the table. Dose to individual workers would be kept low by instituting badged monitoring and ALARA programs and also workers rotations. As a result of the implementation of these mitigation measures, the actual number of fatal cancers calculated would be lower for the operation of this facility.

**Hazardous Chemical Impacts.** Hazardous chemical impacts to the public and to the onsite worker resulting from the normal operations of the new consolidated Pu storage facility at Hanford are presented in Table 4.2.1.9–3. The impacts from all site operations, including the consolidated storage facility, are included in this table. Total site impacts, which include the No Action impact plus the added facility impact, are provided. All analyses to support the values presented in this table are provided in Section M.3.

The HI to the MEI of the public is  $4.0 \times 10^{-6}$ , and the cancer risk is  $2.7 \times 10^{-8}$  as a result of operation of the new consolidated Pu storage facility in the year 2030. The HI and cancer risk would remain constant over 50 years of operation, provided exposures remain the same. The total site operation including the upgrade facility would result in an HI of  $6.6 \times 10^{-5}$  and a cancer risk of  $2.7 \times 10^{-8}$  for the MEI in the year 2030. This would be expected to remain constant as a result of 50 years of operation.

The HI to the onsite worker would be  $2.8 \times 10^{-4}$ , and the cancer risk is  $1.2 \times 10^{-5}$  as a result of operation of the new consolidated Pu storage facility in the year 2030. The HI and cancer risk would remain constant over 50 years of operation, provided exposures remain the same. The total site operation including the upgrade facility would result in an HI of  $4.3 \times 10^{-3}$  and a cancer risk of  $1.2 \times 10^{-5}$  for the MEI in the year 2030. This would be expected to remain constant as a result of 50 years of operation.

**Facility Accidents.** A set of potential accidents for the consolidation of Pu alternative at Hanford for which there may be releases of Pu that may impact onsite workers and the offsite population has been postulated. The accident consequences and risks to a worker located 1,000 m (3,280 feet) from the accident release point, the maximum offsite individual located at the site boundary, and the population located within 80 km (50 mi) of the accident release point are summarized in Table 4.2.1.9–6. For the set of accidents analyzed, the maximum number of cancer fatalities in the population within 80 km (50 mi) would be 1.2 at Hanford for the beyond design basis earthquake accident scenario with an estimated probability of  $1.0 \times 10^{-7}$  per year (that is, probability of severe earthquake occurring is estimated to be about  $1.0 \times 10^{-5}$ , once in 100,000 years, multiplied by a damage and release probability of 0.01). The corresponding 50-year facility lifetime risk from the same accident scenario for the population, maximum offsite individual, and worker at 1,000 m (3,280 ft), would be  $6.1 \times 10^{-6}$ ,  $8.3 \times 10^{-10}$ , and  $1.1 \times 10^{-7}$ , respectively. The maximum population 50-year facility lifetime risk would be  $4.2 \times 10^{-3}$  (that is, one fatality in about 12,000 years) at Hanford for the PCV penetration by corrosion accident scenario with a probability of 0.064 per year. The corresponding maximum offsite individual and worker 50-year facility lifetime risks would be  $5.7 \times 10^{-7}$  and  $5.7 \times 10^{-5}$ , respectively. Section M.5 presents additional facility accident data and summary descriptions of the accident scenarios identified in Table 4.2.1.9–6.

Involved workers, those that would work in the facilities associated with the proposed action, may be subject to injury and, in some cases, fatality as a result of potential accidents. The locations of workstations, number of workers, personnel protective features, engineered safety features, and other design details affect the extent of worker exposures to accidents. Certain accidents such as fires, explosions, and criticality could cause fatalities to workers close to the accident. Prior to construction of a new or modification of an existing facility, DOE Orders require detailed safety analyses to assure that facility designs and operating procedures limit the number of workers in hazardous areas and minimize risk of injury or fatality in the event of an accident.

## Collocation Alternative

### *Construct New Plutonium and Highly Enriched Uranium Storage Facilities*

This section includes a description of radiological and hazardous chemical releases and the associated impacts resulting from either normal operation or accidents involved with the consolidation of Pu storage and collocation with HEU storage facilities at Hanford. This storage would take place in a new Pu and HEU storage facility.

Normal operation of the new collocated storage facility at Hanford would result in impacts that are within applicable regulatory limits.

[Text deleted.]

**Normal Operation.** There would be no radiological releases during the construction of a new collocated storage facility at Hanford. Construction worker exposures to materials potentially contaminated with radioactivity (for

Table 4.2.1.9–6. Consolidation Alternative Accident Impacts at Hanford Site

| Accident Description               | Worker at 1,000 m                                |   | Maximum Offsite Individual                       |   | Population to 80 km                                |  | Accident Frequency (per yr) |
|------------------------------------|--|---|--|---|--|--|-----------------------------|
|                                    | Risk of Cancer Fatality (per 50 yr) <sup>a</sup> | Probability of Cancer Fatality <sup>b</sup> | Risk of Cancer Fatality (per 50 yr) <sup>a</sup> | Probability of Cancer Fatality <sup>b</sup> | Risk of Cancer Fatalities (per 50 yr) <sup>a</sup> | Number of Cancer Fatalities <sup>c</sup> |                             |
| PCV puncture by forklift           | $1.3 \times 10^{-7}$                             | $4.4 \times 10^{-6}$                        | $1.3 \times 10^{-9}$                             | $4.4 \times 10^{-8}$                        | $9.6 \times 10^{-6}$                               | $3.2 \times 10^{-4}$                     | $6.0 \times 10^{-4}$        |
| PCV breach by firearms discharge   | $7.7 \times 10^{-9}$                             | $4.4 \times 10^{-7}$                        | $7.7 \times 10^{-11}$                            | $4.4 \times 10^{-9}$                        | $5.6 \times 10^{-7}$                               | $3.2 \times 10^{-5}$                     | $3.5 \times 10^{-4}$        |
| PCV penetration by corrosion       | $5.7 \times 10^{-5}$                             | $1.8 \times 10^{-5}$                        | $5.7 \times 10^{-7}$                             | $1.8 \times 10^{-7}$                        | $4.2 \times 10^{-3}$                               | $1.3 \times 10^{-3}$                     | 0.064                       |
| Vault fire                         | $5.8 \times 10^{-8}$                             | 0.012                                       | $4.6 \times 10^{-10}$                            | $9.2 \times 10^{-5}$                        | $3.4 \times 10^{-6}$                               | 0.67                                     | $1.0 \times 10^{-7}$        |
| Truck bay fire                     | $3.1 \times 10^{-9}$                             | $6.1 \times 10^{-4}$                        | $3.1 \times 10^{-11}$                            | $6.1 \times 10^{-6}$                        | $2.2 \times 10^{-7}$                               | 0.045                                    | $1.0 \times 10^{-7}$        |
| Spontaneous combustion             | $3.1 \times 10^{-11}$                            | $8.8 \times 10^{-7}$                        | $3.1 \times 10^{-13}$                            | $8.8 \times 10^{-9}$                        | $2.2 \times 10^{-9}$                               | $6.4 \times 10^{-5}$                     | $7.0 \times 10^{-7}$        |
| Explosion in the vault             | $7.2 \times 10^{-11}$                            | $1.4 \times 10^{-3}$                        | $7.2 \times 10^{-11}$                            | $1.4 \times 10^{-5}$                        | $5.3 \times 10^{-7}$                               | 0.11                                     | $1.0 \times 10^{-7}$        |
| Explosion outside of vault         | $3.3 \times 10^{-11}$                            | $6.6 \times 10^{-6}$                        | $3.3 \times 10^{-13}$                            | $6.6 \times 10^{-8}$                        | $2.4 \times 10^{-9}$                               | $4.8 \times 10^{-4}$                     | $1.0 \times 10^{-7}$        |
| Nuclear criticality                | $2.1 \times 10^{-11}$                            | $4.2 \times 10^{-6}$                        | $1.6 \times 10^{-13}$                            | $3.3 \times 10^{-8}$                        | $1.8 \times 10^{-10}$                              | $3.5 \times 10^{-5}$                     | $1.0 \times 10^{-7}$        |
| Beyond evaluation basis earthquake | $1.1 \times 10^{-7}$                             | $2.2 \times 10^{-2}$                        | $8.3 \times 10^{-10}$                            | $1.7 \times 10^{-4}$                        | $6.1 \times 10^{-6}$                               | 1.2                                      | $1.0 \times 10^{-7}$        |
| Expected risk <sup>d</sup>         | $5.8 \times 10^{-5}$                             | –   | $5.8 \times 10^{-7}$                             | –   | $4.3 \times 10^{-3}$                               | –  | –                           |

<sup>a</sup> The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

<sup>b</sup> Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

<sup>c</sup> Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

<sup>d</sup> Expected risk is the sum of the risks for each accident over the 50-year lifetime of the facility.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.2.1.1–5 and M.5.2.1.1–6 and the MACCS computer code.

example, from construction activities involved with existing contaminated soil) would be limited to assure that doses are maintained ALARA. Toward this end, construction workers would be monitored as appropriate. Limited hazardous chemical releases are anticipated as a result of construction activities. However, concentrations would be within the regulated exposure limits. During normal operation, there would be radiological and hazardous chemical releases to the environment as well as direct in-plant exposures. The resulting doses and potential health effects to the public and workers are described below.

**Radiological Impacts.** Radiological impacts to the public resulting from the normal operation of the new collocated storage facility at Hanford are presented in Table 4.2.1.9–1. The impacts from all site operations, including the new storage facility, are also given in the table. To put operational doses into perspective, comparisons of operational doses with natural background radiation doses are included in the table.

The dose to the MEI of the public due to annual storage facility operation would be  $2.5 \times 10^{-6}$  mrem. From 50 years of operation, the corresponding risk of fatal cancer to this individual would be  $6.2 \times 10^{-11}$ . The impacts to the average individual would be less. As a result of storage facility operation in the year 2030, the population

dose would be  $1.1 \times 10^{-4}$  person-rem. The corresponding number of fatal cancers in this population due to 50 years of operation would be  $2.8 \times 10^{-6}$ .

The dose to the MEI of the public due to annual total site operations is within radiological limits and would be  $5.1 \times 10^{-3}$  mrem. From 50 years of operation, the corresponding risk of fatal cancer to this individual would be  $1.3 \times 10^{-7}$ . The impacts to the average individual would be less. This activity would be included in a program to ensure that doses to the public are ALARA. As a result of total site operation in the year 2030, the population dose would be within the limit in proposed 10 CFR 834 and would be 1.5 person-rem. The corresponding number of fatal cancers in this population due to 50 years of operation would be 0.038.

Doses to onsite workers due to normal operations are given in Table 4.2.1.9–2. Included are involved workers directly associated with the new storage facility, workers who are not involved with the new storage facility, and the entire workforce at Hanford. All doses fall within regulatory limits and administrative control levels. The associated risks and numbers of fatal cancers among the different workers from 50 years of operation are included in the table. Dose to individual workers would be kept low by instituting badged monitoring and ALARA programs and also worker rotations. As a result of the implementation of these mitigation measures, the actual number of fatal cancers calculated would be lower for the operation of this facility.

**Hazardous Chemical Impacts.** Hazardous chemical impacts to the public and to the onsite worker resulting from the normal operations of the new consolidation of Pu storage and collocation with HEU storage facilities at Hanford are presented in Table 4.2.1.9–3. The impacts from all site operations, including the consolidation of Pu storage and collocation with HEU storage facilities, are also included in this table. Total site impacts, which include the No Action impact plus the added facility impacts, are provided. All analyses to support the values presented in this table are provided in Section M.3.

The HI to the MEI of the public is  $1.6 \times 10^{-5}$ , and the cancer risk is  $2.7 \times 10^{-8}$  as a result of operation of the new consolidation of Pu storage and collocation with HEU storage facilities in the year 2030. The HI and cancer risk would remain constant over 50 years of operation, because exposures would be expected to remain the same. The total site operation, including the new facility, would result in an HI of  $7.8 \times 10^{-5}$  and a cancer risk of  $2.7 \times 10^{-8}$  for the MEI in the year 2030. This would be expected to remain constant as a result of 50 years of operation.

The HI to the onsite worker is  $7.1 \times 10^{-4}$ , and the cancer risk is  $1.2 \times 10^{-5}$  as a result of operation of the new consolidation of Pu storage and collocation with HEU storage facilities in the year 2030. The HI and cancer risk would remain constant over 50 years of operation, because exposures would be expected to remain the same. The total site operation including the new facility would result in an HI of  $4.7 \times 10^{-3}$  and a cancer risk of  $1.2 \times 10^{-5}$  for the onsite worker in the year 2030. This would be expected to remain constant as a result of 50 years of operation.

**Facility Accidents.** A set of potential accidents for collocation of Pu and HEU at Hanford for which there may be releases of Pu or HEU that may impact onsite workers and the offsite population has been postulated. The consequences and risks of potential accidents for Pu and HEU storage would be bounded by the impacts associated with the release of Pu. The accident consequences and risks to a worker located 1,000 m (3,280 feet) from the accident release point, the maximum offsite individual located at the site boundary, and the population located within 80 km (50 mi) of the accident release point are summarized in Table 4.2.1.9–7. For the set of accidents analyzed, the maximum number of cancer fatalities in the population within 80 km (50 mi) would be 1.2 at Hanford for the beyond design basis earthquake accident scenario with an estimated probability of  $1.0 \times 10^{-7}$  per year (that is, probability of severe earthquake occurring is estimated to be about  $1.0 \times 10^{-5}$ , once in 100,000 years, multiplied by a damage and release probability of 0.01). The corresponding 50-year facility lifetime risk from the same accident scenario for the population, maximum offsite individual, and worker at 1,000 m (3,280 ft), would be  $6.1 \times 10^{-6}$ ,  $8.3 \times 10^{-10}$ , and  $1.1 \times 10^{-7}$ , respectively. The maximum population 50-year facility lifetime risk would be  $4.2 \times 10^{-3}$  (that is, one fatality in about 12,000 years) at Hanford for the PCV penetration by corrosion accident scenario with a probability of 0.064 per year. The corresponding maximum

offsite individual and worker 50-year facility lifetime risks would be  $5.7 \times 10^{-7}$  and  $5.7 \times 10^{-5}$ , respectively. Section M.5 presents additional facility accident data and summary descriptions of the accident scenarios identified in Table 4.2.1.9–7.

Involved workers, those that would work in the facilities associated with the proposed action, may be subject to injury and, in some cases, fatality as a result of potential accidents. The locations of workstations, number of workers, personnel protective features, engineered safety features, and other design details affect the extent of worker exposures to accidents. Certain accidents such as fires, explosions, and criticality could cause fatalities to workers close to the accident. Prior to construction of a new or modification of an existing facility, DOE Orders require detailed safety analyses to assure that facility designs and operating procedures limit the number of workers in hazardous areas and minimize risk of injury or fatality in the event of an accident.

### Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

If the strategic reserve and weapons R&D materials are not included, the incremental impacts to the public and to workers from the accident-free storage activities would be reduced in proportion to the decrease in the amount of material stored. The impacts from total site operations would decrease slightly. This subalternative applies to the Upgrade With All or Some RFETS and LANL Pu Subalternative, the Consolidation Alternative, and the Collocation Alternative. The risks due to accidents would also tend to be lower.

**Table 4.2.1.9–7. Collocation Alternative Accident Impacts at Hanford Site**

| Accident Description                  | Worker at<br>1,000 m                                      |   | Maximum Offsite<br>Individual                             |   | Population to<br>80 km                                      |  | Accident<br>Frequency<br>(per year) |
|---------------------------------------|---|---|---|---|---|--|-------------------------------------|
|                                       | Risk of<br>Cancer<br>Fatality<br>(per 50 yr) <sup>a</sup> | Probability<br>of Cancer<br>Fatality <sup>b</sup> | Risk of<br>Cancer<br>Fatality<br>(per 50 yr) <sup>a</sup> | Probability<br>of Cancer<br>Fatality <sup>b</sup> | Risk of<br>Cancer<br>Fatalities<br>(per 50 yr) <sup>a</sup> | Number of<br>Cancer<br>Fatalities <sup>c</sup> |                                     |
| PCV puncture by forklift              | $1.3 \times 10^{-7}$                                      | $4.4 \times 10^{-6}$                              | $1.3 \times 10^{-9}$                                      | $4.4 \times 10^{-8}$                              | $9.6 \times 10^{-6}$  | $3.2 \times 10^{-4}$                           | $6.0 \times 10^{-4}$                |
| PCV breach by<br>firearms discharge   | $7.7 \times 10^{-9}$                                      | $4.4 \times 10^{-7}$                              | $7.7 \times 10^{-11}$                                     | $4.4 \times 10^{-9}$                              | $5.6 \times 10^{-7}$  | $3.2 \times 10^{-5}$                           | $3.5 \times 10^{-4}$                |
| PCV penetration<br>by corrosion       | $5.7 \times 10^{-5}$                                      | $1.8 \times 10^{-5}$                              | $5.7 \times 10^{-7}$                                      | $1.8 \times 10^{-7}$                              | $4.2 \times 10^{-3}$  | $1.3 \times 10^{-3}$                           | 0.064                               |
| Vault fire                            | $5.8 \times 10^{-8}$                                      | 0.012   | $4.6 \times 10^{-10}$                                     | $9.2 \times 10^{-5}$                              | $3.4 \times 10^{-6}$  | 0.67   | $1.0 \times 10^{-7}$                |
| Truck bay fire                        | $3.1 \times 10^{-9}$                                      | $6.1 \times 10^{-4}$                              | $3.1 \times 10^{-11}$                                     | $6.1 \times 10^{-6}$                              | $2.2 \times 10^{-7}$  | 0.045  | $1.0 \times 10^{-7}$                |
| Spontaneous combustion                | $3.1 \times 10^{-11}$                                     | $8.8 \times 10^{-7}$                              | $3.1 \times 10^{-13}$                                     | $8.8 \times 10^{-9}$                              | $2.2 \times 10^{-9}$  | $6.4 \times 10^{-5}$                           | $7.0 \times 10^{-7}$                |
| Explosion in the vault                | $7.2 \times 10^{-9}$                                      | $1.4 \times 10^{-3}$                              | $7.2 \times 10^{-11}$                                     | $1.4 \times 10^{-5}$                              | $5.3 \times 10^{-7}$  | 0.11   | $1.0 \times 10^{-7}$                |
| Explosion outside of vault            | $3.3 \times 10^{-11}$                                     | $6.6 \times 10^{-6}$                              | $3.3 \times 10^{-13}$                                     | $6.6 \times 10^{-8}$                              | $2.4 \times 10^{-9}$  | $4.8 \times 10^{-4}$                           | $1.0 \times 10^{-7}$                |
| Nuclear criticality                   | $2.1 \times 10^{-11}$                                     | $4.2 \times 10^{-6}$                              | $1.6 \times 10^{-13}$                                     | $3.3 \times 10^{-8}$                              | $1.8 \times 10^{-10}$                                       | $3.5 \times 10^{-5}$                           | $1.0 \times 10^{-7}$                |
| Beyond evaluation basis<br>earthquake | $1.1 \times 10^{-7}$                                      | 0.022   | $8.3 \times 10^{-10}$                                     | $1.7 \times 10^{-4}$                              | $6.1 \times 10^{-6}$  | 1.2  | $1.0 \times 10^{-7}$                |
| Expected risk <sup>d</sup>            | $5.8 \times 10^{-5}$                                      | –   | $5.8 \times 10^{-7}$                                      | –   | $4.3 \times 10^{-3}$  | –  | –                                   |

<sup>a</sup> The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

<sup>b</sup> Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

<sup>c</sup> Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

<sup>d</sup> Expected risk is the sum of the risks for each accident over the 50-year lifetime of the facility.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.2.2.1–3 and M.5.2.2.1–4 and the MACCS computer code.

## **Phaseout**

**Normal Operation.** A phaseout of existing Pu storage facilities at Hanford would reduce the impacts from radiological and chemical releases and exposures to levels slightly less than the No Action exposures. As shown in Table 4.2.1.9-1, the dose to the MEI from annual operation would be reduced by  $4.1 \times 10^{-4}$  mrem; the dose to the population would be reduced by 0.047 person-rem. The associated reductions in fatal cancer are included in the table. All workers involved in the transfer of the Pu would be monitored to assure that their doses remain within regulatory limits and ALARA.

**Facility Accidents.** The phaseout operation will be conducted in accordance with DOE Orders to ensure that the risk to the public of prompt fatalities due to accidents or of cancer fatalities due to operations will be minimized. For current operations in the facility that would be phased out, the safety of workers and the public from accidents is controlled by Technical Safety Requirements that are specified in SARs or Basis for Interim Operations documents that have been prepared for the facility. Prior to initiating phaseout, the potential for accidents that could affect workers and the public will be assessed and, if necessary, applicable existing safety documentation will be modified to ensure safety for workers and the public.